Giant

LLOWKNIFE MINES LIMITED

GIANT YELLOWKNIFE MINES LIMITED

WELCOME

Whether you're paying us a short visit or joining us as a new employee, we welcome you to Giant Yellowknife Mines Limited and know you'll enjoy the time you spend here.

If you would like to learn something about gold mining, this booklet should give you an understanding of how it is done at Giant.

We are proud of the operations and think that Giant is a fine place in which to work. With its lively community spirit and scenic location, Yellowknife too, can be interesting. Most of the families who have settled here look forward to becoming long-term residents.

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A BRIEF HISTORY

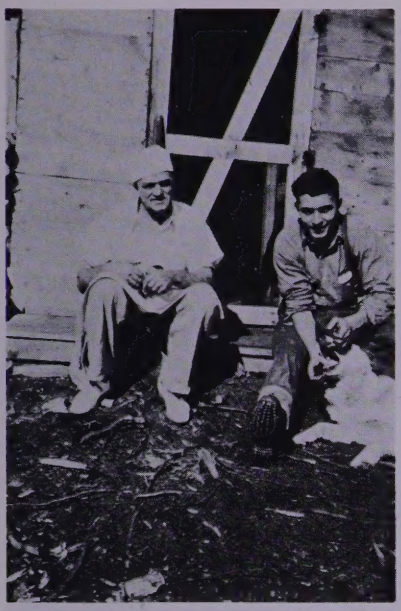
Gold was first found in the Yellowknife region in 1896 by miners on their way to the Klondike, but sporadic prospecting revealed nothing of importance. It took the Fort Norman oil find and the discovery of radium-bearing ores at Great Bear Lake to speed up the search for minerals in the Northwest Territories. In 1934, visible gold found on the east shore of Yellowknife Bay brought about a staking rush in the area.

The original 21 Giant claims were staked in July 1935 by C.J. Baker and H. M. Muir, prospectors with Burwash Yellowknife Mines Limited, after much of the east side of the bay had been staked but prior to the discovery of visible gold on the west side.

Giant Yellowknife Mines Limited was incorporated in August 1937. During the next few years the property was investigated and drilled but with little encouragement.

Meanwhile, a geological survey party reported visible gold immediately south of the Giant claims and activity that followed resulted in several small high-grade properties being worked. Development of Yellowknife as a mining community had begun.

Encouraging results were not obtained at Giant until 1941 when Don W. Cameron, a veteran prospector with Frobisher Explorations (a sub-



sidiary of Ventures Ltd.), re-examined a promising quartz occurrence near the southeast boundary of the property. An agreement was signed in June 1943 under which Frobisher gained management control of Giant Yellowknife Mines Limited.

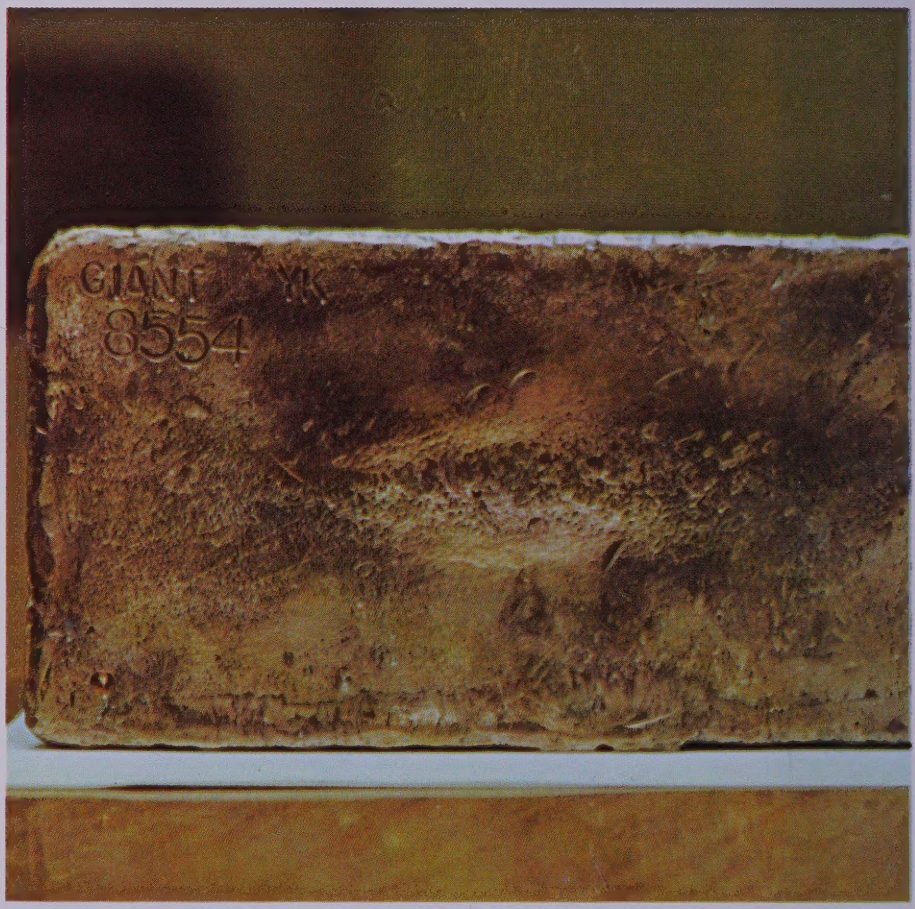
Frobisher's consulting geologist, Dr. A. S. Dadson, to whom was assigned the task of working out the complex geology of the area, deduced that the Baker Creek Valley, extending through the property to the east of the West Bay Fault, might be underlain by a major gold-bearing shear zone system. He embarked on an extensive diamond drilling program to test his theory. The spectacular results suggested an ore deposit far exceeding in size and grade any known in the Northwest Territories and initiated an unprecedented rush to stake, re-stake and prospect throughout the Yellowknife region.

Giant's subsequent history has continued to justify the high hopes raised by the drilling. Plans were adopted in keeping with the idea of a big mine. The first gold brick was poured in May of 1948 and since then more than 6,500,000 ounces have been produced, valuing more than $300,000,000.

In 1962 Ventures Ltd. merged with the Falconbridge Group of Companies. Two adjacent properties operated by Giant are Lolor Mines Limited (87% owned) and Supercrest Mines Limited (50% owned).

GOLD

Through the ages men have wanted gold for ornaments because of its beautiful color and freedom from tarnish. Examples of elaborate gold workmanship survive from ancient civilizations, many in nearly perfect condition. The development of a more complex economic system gave gold a new major function as high denomination currency and later as backing for paper currency systems. So precious was gold in the Middle Ages that the foundation of chemistry derived largely from the vain experiments of medieval alchemists seeking to convert other metals into gold.



Until recent times, the combination of high demand and limited supply made gold the most precious metal. The total world production from 1500 to the discovery of the California gold fields in 1849, was less than one year's output today. Canada ranks third in world production, after South Africa and the U.S.S.R.

Throughout the centuries gold has been recovered in many ways. However gold production in Canada today is mainly obtained by the use of the cyanide process, such as that employed at Giant. Water solu-

ble and very poisonous cyanide is one of the few chemicals which can dissolve gold. Peculiarly, a weak cyanide solution attacks the gold particles faster than a strong solution.

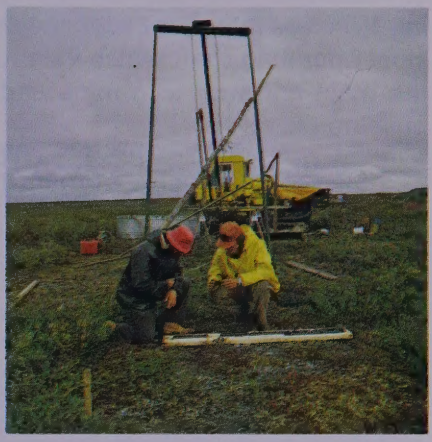
Gold is distributed in trace amounts throughout the world. Visible gold, though, is very rare.

In contrast with ores of other metals, gold ores contain only minute quantities of the desired metal. However, modern cyanide mills are so efficient that ores containing as little as five parts of gold per one million parts of waste rock can be profitably treated.

Gold, when pure, is the most malleable and ductile of metals; it can be beaten to a thickness of 1/300,000 of an inch, or drawn out into a very fine wire.

Because of these properties gold is used for electrical contacts, laboratory equipment, cameras, computers and earth satellites as protection against heat and corrosion. It also has important uses in the field of optics, atomic energy, heat control and measurement, dentistry and medical therapy. But the consumption of gold in jewellery and the decorative arts still accounts for about 70% of the world's production.

The orebodies of the Giant Yellowknife Mine occur in zones of schist, in an assemblage of typical Archean volcanic rocks which form part of the Yellowknife Greenstone Belt. These rocks are about 2.7 billion years old. Schist is a foliated metamorphic rock whose grains have a roughly parallel arrangement. It is most often formed by shearing or fault movement. The favourable schist zone has been traced for a length of more than three miles to a depth of 2,000 feet.



Gold was probably carried by hot aqueous solutions from great depth. These solutions rose along fractures in the earth's crust, depositing gold and other metals in the schist zones.

Great earth movements along several structural faults took place subsequent to formation of the gold deposits. The greatest of these is the West Bay fault, which bisects the Yellowknife Greenstone Belt at an acute angle. It crosses the southern portion of the Giant property, and also marks the southern limit of the Giant ore zones. The Campbell Zone of the Con Mine, three miles to the south, is thought to be the continuation of the Giant system.

The gold ore at Giant appears at irregular intervals throughout the schist and is characterized by 40% to 80% quartz-carbonate and about 10% pyrite and arsenopyrite. The gold associated with sulphides forms a refractory ore, which causes milling and metallurgical complications.

Individual orebodies are extremely diverse in respect to grade, size and shape. Lengths of individual stopes or working places have varied from 50 to 400 feet and widths from less than 10 feet to more than 100 feet. Because of abrupt changes in dimension and attitude of individual ore shoots, close geological control is necessary to maintain profitable grades. Stope geologists and samplers visit each working place daily in order to mark ore contacts and give production supervisors necessary information as to location of ore for future mining.

To locate and define new orebodies, more than 100,000 feet of diamond drilling is done on the property each year. All pertinent geological and assay data are plotted on mine plans and sections.

In addition to the search for ore on the mine property, Giant also carries out extensive exploration for new orebodies throughout the Northwest Territories and elsewhere in Canada. Field work is done predominantly during the four summer months but some projects, especially those involving geophysical methods, are done in winter.

THE MINE

Visitors to Giant are first impressed by the 'C' headframe, an imposing structure that dominates the mine site. It is set over the mine's principal operating shaft which extends to a depth of 2,124 feet. A shaft is the main entrance to a mine and resembles an elevator shaft in a tall building.

'C' shaft is equipped with an 18-man aluminum 'cage', two skips for hoisting ore and waste to the surface, and emergency ladder-way. Access to underground workings at Giant is provided through four shafts, three large service raises and two declines, not all of which are presently in operation.

Miners descend into the underground areas to stations at various levels from which passageways lead off to the areas where they work.

The stope is the workshop of the mine where the ore is first broken for transportation to the mill. Four methods of stope mining are employed at Giant. In determining which method is more suitable in a particular

area, the safety of the miner, the size, shape and grade of the orebody, and the rock or ground conditions, are all taken into consideration.

LONGHOLE STOPING — 70%

This method is applied in mining large and steeply dipping orebodies whose wall rocks will stand without support over considerable spans of excavation. A drift in ore is driven at the bottom of the stope and sub-drifts at 40 to 60 foot intervals of elevation extend the length of the orebody. Vertical slices of ore are then drilled and blasted to fall into the drawpoints at the bottom where the broken ore is loaded and moved to the shaft.

SHRINKAGE STOPING — 10%

In this method, a horizontal slice is mined and broken. Then sufficient ore is pulled from the drawpoints to allow working space for the next layer to be drilled and blasted.

OPEN STOPING — 10%

Open stoping is used to mine very flat laying or slightly inclined orebodies where no other method is suitable. These stopes are usually no more than 10 to 15 feet high. Broken ore is 'slushed' into mill holes from which the ore trains load their cars.

CUT-AND-FILL STOPING — 10%

This method is employed in mining orebodies with difficult ground conditions. The ore is mined from the bottom up, drilling and blasting ore lengthwise, horizontal slice at a time. Broken ore is transferred to mill holes by slusher or by rubber-tired load-haul-dump vehicles. After all the broken ore is removed from the stope, a new floor of waste rock is constructed (partly to support the exposed walls and partly to enable the miner to reach the new slice for drilling) and the cycle begins again.

CONTROL

The mine engineers keep close tab on the stope as it advances. Twice a month stopes are surveyed to determine the dimensions and location of the ore which has been extracted. These data are recorded on maps kept in the Engineering Office. Besides being useful to the geological department, it provides the basis for calculating the bonus to be paid to the miners, most of whom work on an incentive system.

Giant works on a central blasting system, with explosives being detonated electrically from surface at 4 p.m. and 4 a.m., when all the men have evacuated the mine.

Ventilation to the mine is provided by four fans producing 90,000 cubic feet per minute of fresh air. Air is forced down 'B' shaft to 750 Level at which point it is divided. During winter; ventilating air is heated by a large propane heater to ensure hospitable working conditions and to prevent freezing of water lines.

The mine's compressed air supply is provided by 11 compressors at 5 locations. The compressed air is used to power rock drills, loaders, diamond drills and some slushers.

OPEN PIT MINING

With improvements in gold price, an open pit mine was started in 1974 on low-grade ore located 3,000 feet south of 'C' shaft. It was completed in 1979. Three smaller pits are now being worked.

Although on first appearance the open pit operation may look simple, in its engineering and economic aspects it is anything but that. It calls for close planning in minute detail before any excavation takes place.

Front end loaders are used to load 35-ton trucks for hauling the ore to 'C' shaft. The ore is dumped either down a pass to the underground crusher or onto a new conveyor installation leading to surface crushers, or stock-piled and fed to the mill as required.

Sufficient ore is produced from the pits and underground to allow the mill to be operated at full capacity, 1,200 tons per day, seven days per week.

A-1 PIT

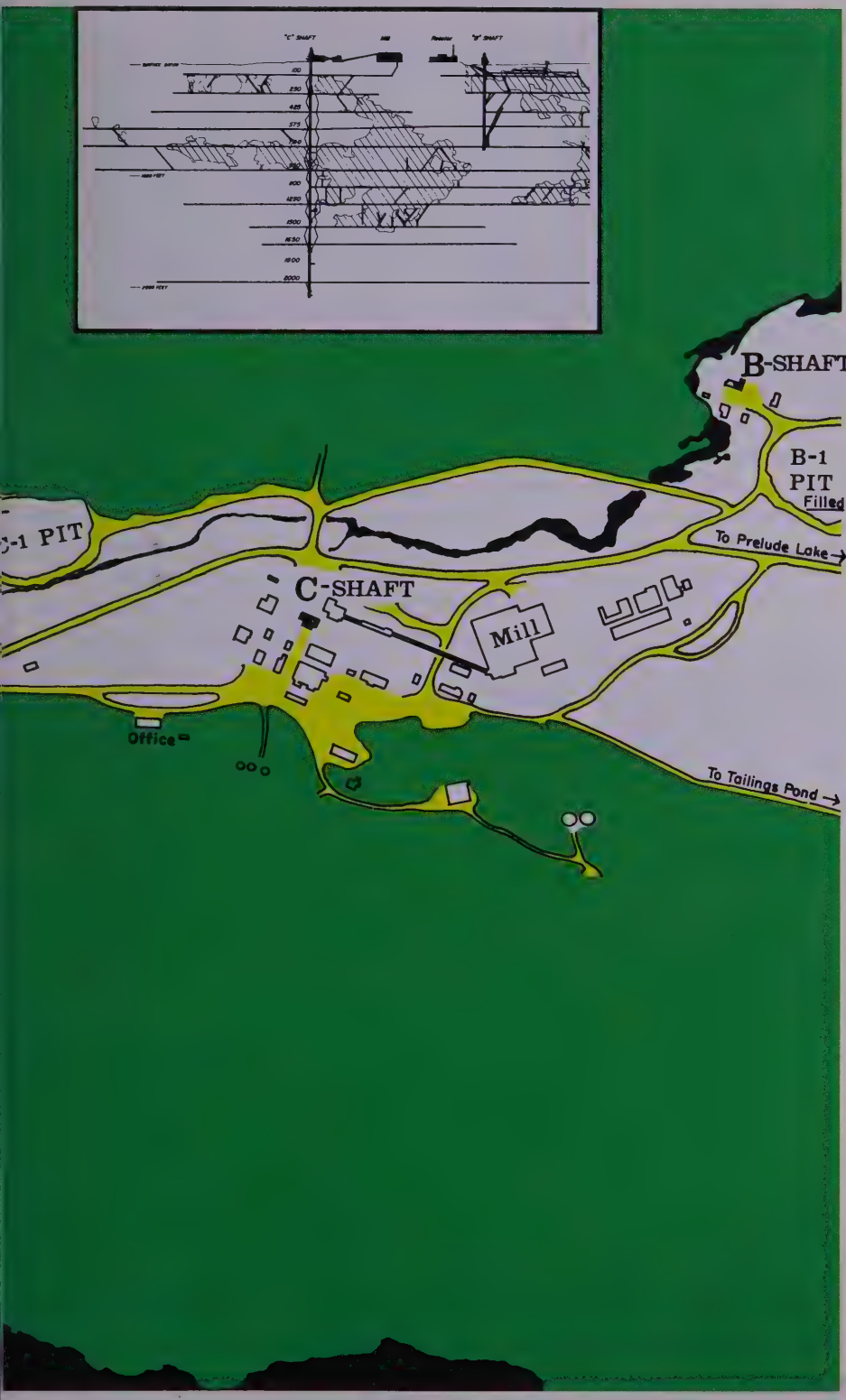
baker creek

A-SHAFT

A-2 PIT

CITY

YELLOWKNIFE BAY


B-SHAFT
B-1
PIT
Filled
To Prelude Lake
C-1 PIT
C-SHAFT
Mill
Office
To Tailings Pond

THE MILL

A layman visiting the mill is impressed by a baffling maze of tanks, pipes, crushers and conveyors. The seeming confusion is actually a carefully integrated system with one objective — the recovery of gold.

The first step in gold milling is the crushing and grinding of the ore coming from the mine. Six to seven inch pieces of ore hoisted to surface are transported by conveyor from a storage bin at 'C' headframe to a series of jaw and cone crushers. These crushers break the ore into 3/8 inch size 'gravel' which is then conveyed to four 500-ton bins in the mill.

The crushed ore is drawn off these storage bins and fed to two 8' × 10' ball mills (large rotating drums containing 3 inch diameter steel balls) where the ore is combined with water and ground to a fine sand. This fine grinding is required to liberate the gold bearing mineral, called arsenopyrite, from the host waste rock.

The fine grained ore slurry is pumped from the ball mills to the flotation circuit where the arsenopyrite is separated from the waste rock. The flotation circuit is visually impressive yet deceptive as the gold colored froth is not indicative of gold. Air is blown into an agitated mixture of ore, water and chemical additives. A commercial frothing agent causes the water to foam while a collecting agent called Xanthate selectively coats the surfaces of the gold bearing mineral arsenopyrite. The Xanthate prefers air to water and thus attaches itself to the surface. The mineral laden bubbles are skimmed off the surface, leaving the waste material behind to be pumped to an impoundment area called a tailings pond. The arsenopyrite skimmed off the flotation circuit is called flotation concentrate as it represents only 10% of the weight of ore treated, yet contains close to 96% of the gold.

The flotation concentrate is pumped to the roasting section of the plant for removal of sulphur, arsenic and antimony, all of which interfere with the recovery of gold. The roaster feed is metered at 78% solids into a two stage fluosolids roaster operating at temperatures in excess of 482° C. Under these temperatures and the action of oxidation the gold bearing mineral, arsenopyrite, is broken down into its constituent elements releasing sulphur and arsenic in the gaseous phase while the gold remains locked in a matrix of iron oxides (principally hematite and magnetite) called roaster calcine. The gas coming off the roaster is treated for recovery of both dust and arsenic with efficiencies in excess of 99.5% being achieved.

The roaster calcine is washed in water and pumped back to the main mill building where sodium cyanide and lime are added. These agents, in the presence of oxygen, dissolve the gold from the calcine. The resulting gold bearing or 'pregnant' solution is separated from the solid waste material using thickeners and filters. The clear pregnant solution is then deoxygenated and gold is precipitated out by adding zinc dust.

The precipitate is refined into gold bullion bars in a tilting bullion furnace. The bars are stamped, weighed and analyzed to determine purity and then shipped to the Royal Canadian Mint in Ottawa for further refining. Bullion produced at Giant is approximately 20 carat gold.

Dust from the roasting process is collected in an electrostatic precipitator. The gold contained in the dust is extracted by a similar cyanide process as used on roaster calcine, but using activated carbon (made from peach pits) as the collecting agent. About 4% of the total gold output is recovered in this way. The carbon concentrate is sent to the United States for refining at a custom smelter.

Total recovery of gold from the complex Giant ore is approximately 88.0%. Close to 1,200 tons of ore are processed daily.

Though the milling process sounds fairly straight forward, each step is monitored by trained operators, technologists and chemists. Constant study and test work are required to react to ore changes and to improve gold recoveries.

ASSAYING

Control from mining operations is provided by the Assay Office where some 400 samples per day are analyzed for gold and silver or iron, sulphur, arsenic, and antimony.

The centuries old method of fire assaying is still used, but the greater part of the work is done by Atomic Absorption Spectrophotometry. This is a fast and economical method involving minimum sample handling.

ENVIRONMENTAL CONTROL

Awareness of our daily impact on the environment surrounding us has grown markedly in the past ten years and Giant Yellowknife Mines is no exception. It was realized soon after the operation started that an environmental control program would have to be developed and followed.

Gold present in the Giant ore is intricately bound with arsenic bearing materials. This arsenic is fumed off as a gas during the roasting operation. In October of 1951 a cold electrostatic precipitator plant was installed to collect the arsenic fumes and dust given off during roasting. In 1955 a second hot electrostatic precipitator was added in tandem for more efficient collection of the dust, and in November 1978 a Dracco baghouse was installed to collect the fine grained arsenic condensed from the roaster gas. Collection efficiency of the system is now better than 99.5% with yearly improvements still being made. The application

of this technology at Giant has resulted in ambient arsenic levels that are well within government standards.

The collected arsenic is pumped to special chambers prepared in competent bed rock in the upper parts of the mine where the ground is permanently frozen. These chambers are hermetically sealed and separated from the rest of the mine by massive concrete bulkheads capable of withstanding from 4 to 12 times the hydrostatic head that could develop if the mine should flood after closure.

Effluent water quality has also received close attention from Giant. The waste from the mill is treated with 3000 pounds of lime per day and pumped to a 112 acre tailings pond system surrounded by impervious dams. The solids settle out in the first pond allowing the clear overflow water to be decanted into a second pond to ensure complete settling. The effluent from the second pond is decanted into Baker Creek. The lime is added to remove as a precipitate any soluble arsenic or heavy metals dissolved in the milling process. The local water course as well as the tailings pond decant is monitored regularly for pollutants. Extensive research is being conducted continually by Giant personnel in a search for a means to improve effluent levels.

Throughout the productive life of the mine Giant has kept pace with new and advanced technology to safeguard health and protect the environment. The importance of industrial hygiene is continually being stressed as evidenced by the following programs:

1. Concentrations of airborne dust and arsenic are monitored throughout the mill working environment to ensure levels that meet the Canadian Public Health Association's recommended levels.
2. In work areas where exposure to contaminants are highest, protective equipment and suits have been developed to further reduce an employee's risk of exposure to dust and arsenic.
3. Both daily and monthly air quality is monitored in the workplace to protect against any exposure of an employee to hazardous gases or fumes.

Measures adopted have been developed to standards approved by the federal authorities and are designed to protect against both present and future contamination. It is Company policy to afford full co-operation to government authorities and to collaborate with them in further improvement in the technology of environmental control.

SAFETY

Considerable importance is given to accident prevention and industrial health throughout the entire operation. Safety instruction is given to all employees and a continuing program of education is carried on. Meetings, poster displays and encouragement of safe working habits all contribute to the prevention of accidents and injuries. Machine guards, protective clothing and hearing protection are utilized to safeguard employees.

First aid courses are offered to employees throughout the year. Approximately 80 new employees are trained in this field each year. Some employees, because of outstanding qualities and job proficiency, are selected to take the Advanced First Aid course, and the Instructor's course.

In 1976 the Company won the Regional John T. Ryan trophy for the lowest accident frequency amongst metalliferous mines in the Prairie Provinces and the Northwest Territories.

WORKING AT GIANT

Over 340 men and women contribute to making the Giant Yellowknife Mines operations run smoothly and efficiently. There are five major areas in which the employees work.

MINE DEPARTMENT

Underground is staffed by 13 supervisors and 124 hourly-rated employees. The crew works on a day and night shift five days a week. Training schools for stope miners and mucking machine operators are held continuously. The open pit is staffed by two supervisors and a crew of 17 working on three shifts, six days per week.

MILL OPERATIONS

The complexities of the milling process are such that a wide variety of technical maintenance and professional skills are necessary to extract gold from the ore. Jobs of the 67 people involved range from doing

chemical analysis and planning improvements to operating and maintaining the mill machinery.

SHOPS AND SERVICES

The Mechanical, Electrical and Construction departments employ close to 100 people. They are responsible for the maintenance and repair of all equipment and buildings on the property.

ENGINEERING AND GEOLOGY SERVICES

The 26 people in this area outline ore reserves by exploration and produce plans to achieve the tonnages and grade objectives set by management. They provide technical assistance to all departments. Geological data are gathered by observation, mapping and by diamond drill core logging.

ADMINISTRATIVE SERVICES

The management, personnel and accounting functions are handled by the office staff. The bulk of the accounting functions are calculated by computer. Living so far from factories necessitates carrying a large stock of parts and supplies in the Warehouse. The smooth operation of the plant depends to a large extent on the skill of the Purchasing Agent and his staff in gauging requirements and finding suppliers.

In order to help maintain a stable work force, the Company provides subsidized housing for married employees as well as eight bunkhouses and a staffhouse to accomodate single personnel. A cost-of-living allowance is given to those employees who reside in the City of Yellowknife.

Other benefits include low cost medical, sick leave, dental and insurance plans. The Company also offers a non-contributory pension plan. Because of the remote location, there is a generous vacation plan

that includes return air-fare to Edmonton for employees and their immediate dependants.

The Company strongly supports the N.W.T. Apprenticeship Program and throughout the Company employees are trained on-the-job and promoted according to their talents and skills. Employees are also encouraged to take advantage of correspondence courses and evening classes offered in Yellowknife.

Each year Giant provides an undergraduate scholarship in honour of the late Dr. A. S. Dadson to a student whose home is in the Northwest Territories. During the summer months students are employed in several departments of the mine.

The Company supports a Recreation Association to which each employee contributes a small monthly fee. The Association operates a recreation hall with snack bar and library. Television, cards, chess, darts, table tennis and billiards are available for the member's enjoyment.

Giant also operates a two-sheet curling rink and sponsors teams in softball, basketball and hockey.

LIVING IN YELLOWKNIFE

From its early days as a community of log cabins and tent frame houses huddled on the north shore of Great Slave Lake, Yellowknife has grown into a bustling, modern city of more than 10,000 people. The city was designated as the capital of the Northwest Territories in 1967.

Yellowknife is linked to Edmonton, Alberta by an all-weather highway, some 1,512 kilometers in length and daily jet air service. It serves as a distribution center for much of northwestern Canada.

Yellowknife has all the facilities of any other Canadian city of its size including hospital, high schools, banks, numerous shops, hotels, motels, restaurants, movie theatres, ball parks, tennis courts, golf course, hockey and curling rinks as well as a swimming pool.

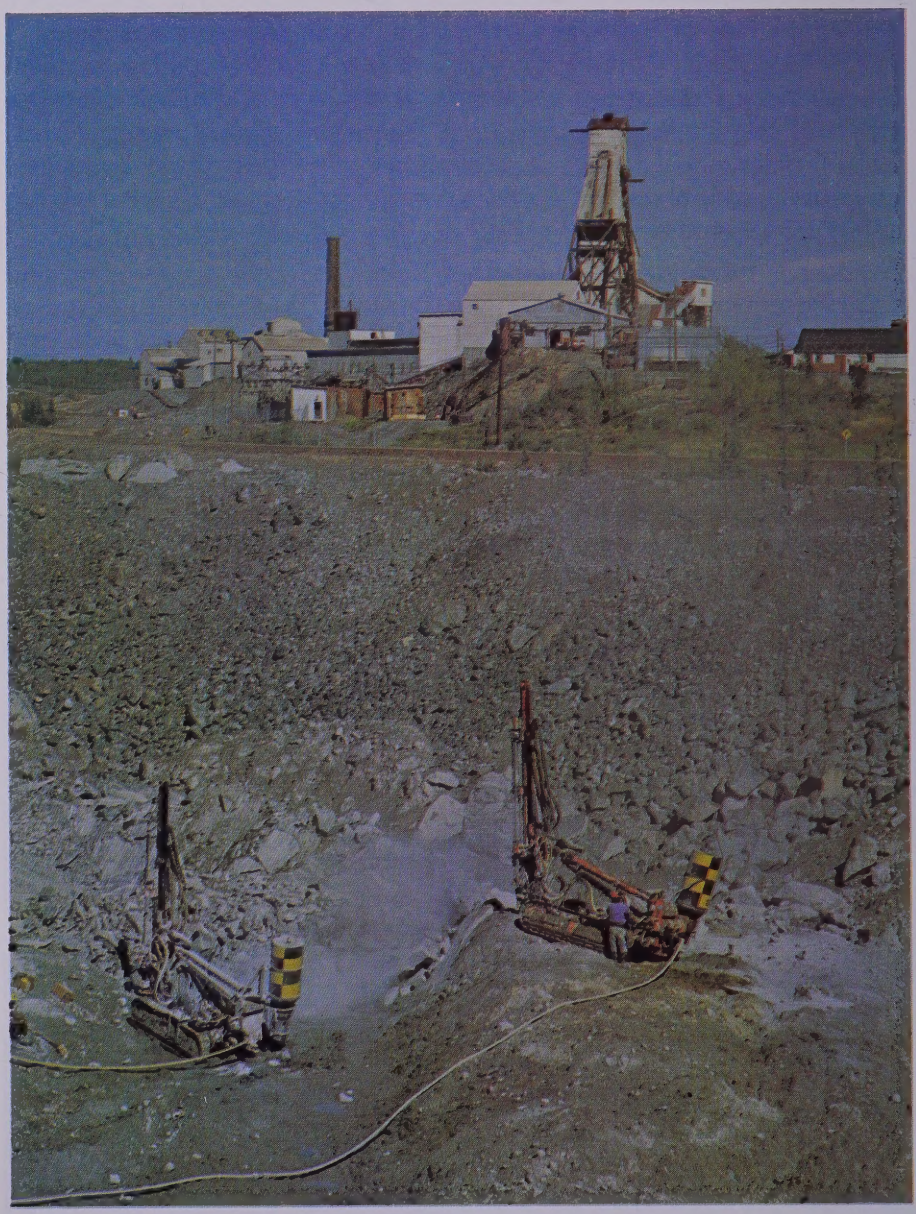
The city boasts a great number of clubs and associations. For example there is a city band, a pipe band, a choral society, a drama group, a film society, a craft guild and a square dancing group. Recreational clubs exist that are devoted to such sports as baseball, broomball, hockey, swimming, sailing, canoeing, curling, snowmobiling, skiing, volleyball, tennis, cricket, soccer, badminton and gymnastics. Excellent hunting, fishing and boating are to be found in the district.

There are two weekly newspapers serving the city and two radio stations, CFYK and CJCD. C.B.C. television provides relay service via satellite from Vancouver and MacKenzie Media broadcasts live local television via cable in addition to videotapes from independant television from the south.

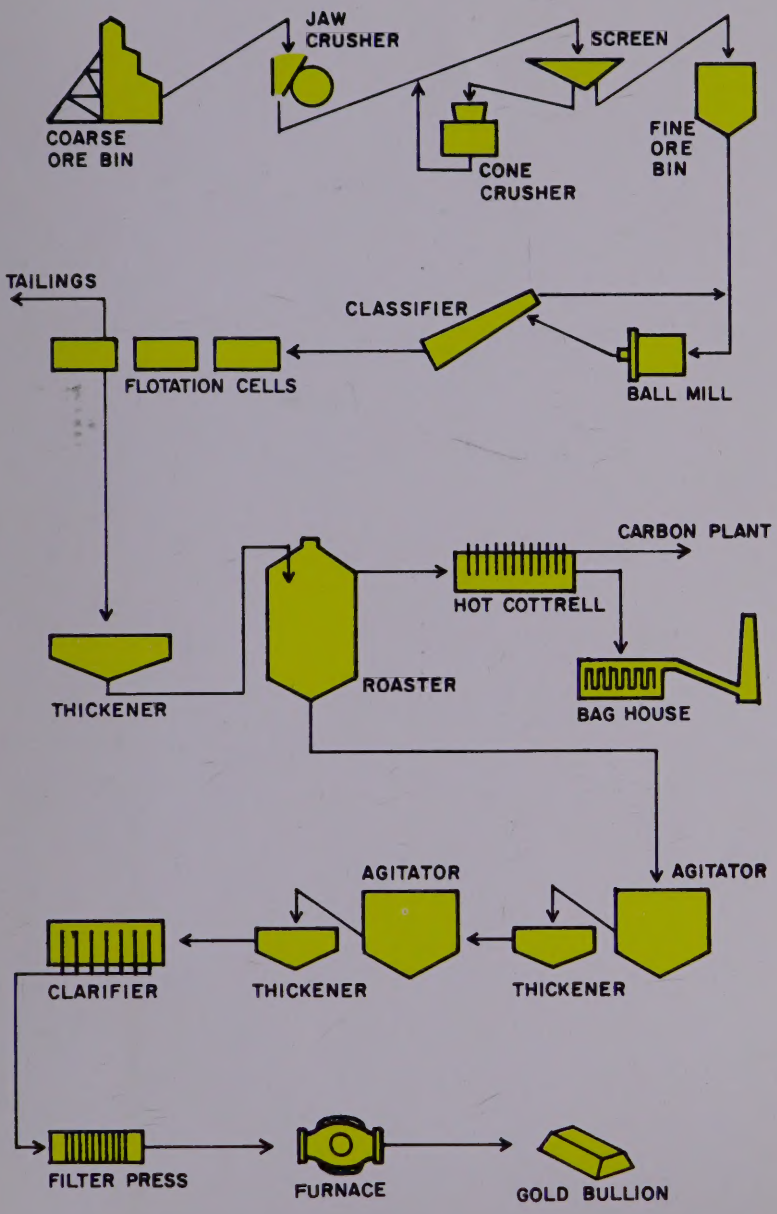
The topography of the Yellowknife area is typical of the Precambrian Shield. Though flat in general, the country is rugged in detail with rocky hills and ridges rising abruptly from innumerable lakes and muskegs. Almost continuous outcrop is present throughout the district but stands of spruce, pine, birch and poplar in valleys and on sand plains tend to soften the overall landscape.

There is no denying the fact that Yellowknife winters are long and cold. Mean temperature for January is -29.0° C but clear, dry air makes the winters seem harsh. Many Yellowknifers prefer the blue skies and clear, cold days to the overcast, slushy conditions of many southern cities. Summers are warm and pleasant with a mean temperature in July of +16.0° C. Annual precipitation is less than 33 cm per year, of which approximately 13 cm is snow.

Gardening is possible due to the long hours of sunlight in June and July. There are approximately 92 frost-free days.



SIMPLIFIED MILLING FLOW SHEET



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